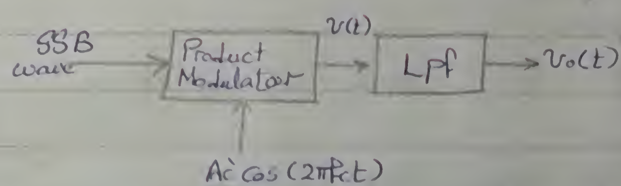
* Demodulation of SSB *

(1) Coherent Detector

Product modulator & LPF



this signal must be coherent " same f and phase as the carrier in the SSB wave " for accurate detection.

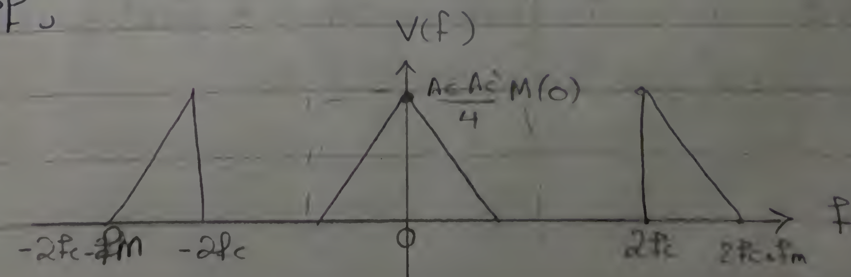
$$v(t) = s(t) * A_c' \cos(2\pi f_c t)$$

$$v(t) = \frac{A_c}{2} \cdot A_c' \cos(2\pi f_c t)\left[m(t)\cos(2\pi f_c t) \pm \hat{m}(t)\sin(2\pi f_c t)\right]$$

$$= \frac{A_c \cdot A_c'}{2}\left[m(t)\cdot\cos^2(2\pi f_c t) \pm \hat{m}(t)\sin(2\pi f_c t)\cos(2\pi f_c t)\right]$$

$$= \frac{A_c A_c'}{2}\left[\frac{m(t)}{2}\left(1+\cos(4\pi f_c t)\right) \pm \frac{\hat{m}(t)}{2}\left[\underbrace{\sin(0)}_{0} + \sin(4\pi f_c t)\right]\right]$$

$$= \underbrace{\frac{A_c A_c'}{4} m(t)}_{\text{المطلوب أعديه لـ LPF}} + \underbrace{\frac{A_c A_c'}{4}\left[m(t)\cos(4\pi f_c t) \pm \hat{m}(t)\sin(4\pi f_c t)\right]}_{\text{إشارة SSB عند } 2f_c}$$



$$\therefore v_o(t) = \frac{A_c A_c'}{4} m(t).$$

If the oscillator's signal $A_c' \cdot \cos(2\pi f_c t)$ subjected

① Freq. shift

$$A_c' \cdot \cos(2\pi f_c t) \longrightarrow A_c' \cdot \cos(2\pi (f_c + \Delta f) t)$$

$$\therefore v(t) = \frac{A_c}{2} \cdot A_c' \cos(2\pi (f_c + \Delta f) t) \cdot \left[m(t) \cdot \cos(2\pi f_c t) \pm \hat{m}(t) \sin(2\pi f_c t) \right]$$

$$= \frac{A_c \cdot A_c'}{2} \left[\frac{m(t)}{2} \cdot \left[\cos(2\pi \Delta f t) + \underbrace{\cos(4\pi f_c t + 2\pi \Delta f t)}_{\text{rejected by LPF}} \right] \right.$$

$$\left. \pm \frac{\hat{m}(t)}{2} \left[\sin(-2\pi \Delta f t) + \underbrace{\sin(4\pi f_c t + 2\pi \Delta f t)}_{\text{rejected by LPF}} \right] \right]$$

$$\bullet \ \sin A * \cos B = \frac{1}{2} \left[\sin(A - B) + \sin(A + B) \right]$$

$$\therefore v_o(t) = \frac{A_c \cdot A_c'}{4} \cdot \left[m(t) \cos(2\pi \Delta f t) \mp \hat{m}(t) \sin(2\pi \Delta f t) \right]$$

معادلة SSB

② Phase shift

$$A_c' \cos(2\pi f_c t) \longrightarrow A_c' \cdot \cos(2\pi f_c t + \phi)$$

$$\therefore v(t) = \frac{A_c}{2} \cdot A_c' \cos(2\pi f_c t + \phi) \cdot \left[m(t) \cos(2\pi f_c t) \pm \hat{m}(t) \sin(2\pi f_c t) \right]$$

$$= \frac{A_c \cdot A_c'}{2} \left[\frac{m(t)}{2} \left(\cos(\phi) + \underbrace{\cos(4\pi f_c t + \phi)}_{\text{rejected by LPF}} \right) \pm \frac{\hat{m}(t)}{2} \left(\sin(-\phi) + \underbrace{\sin(4\pi f_c t + \phi)}_{\text{rejected by LPF}} \right) \right]$$

$$=$$

$$v_o(t) = \frac{A_c A_c'}{4} \left[m(t) \cos\phi \mp \hat{m}(t) \sin(\phi) \right] \longrightarrow \text{SSB معادلة}$$

So $m(t)$ can't be detected